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PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Manfred REISS	Serial No.:	unknown
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By: _____
Name: Chris Stordahl

PRELIMINARY AMENDMENT

Box PCT
Assistant Commissioner for Patents
Washington, D. C. 20231

Dear Sir:

In connection with the above-identified application filed herewith, please enter the following preliminary amendment.

IN THE ABSTRACT

Insert the attached Abstract page into the application as the last page thereof.

IN THE SPECIFICATION

Enclosed is a substitute specification.

IN THE CLAIMS

Please amend claims 1-6 as follows:

1. (Amended) Temperature detection device for an electronic circuit comprising

a temperature detector which outputs a temperature-dependent voltage that is a predetermined function of its temperature;

an analog-to-digital converter to an input of which the temperature-dependent voltage is applied; and

a standardized serial bus to which the output of the analog-to-digital converter is connected.

2. (Amended) Temperature detection device according to Claim 1, wherein the temperature detector is in the form of a voltage divider comprising a temperature sensor and a resistance element.

3. (Amended) Temperature detection device according to Claim 2, wherein the temperature sensor comprises one of a barretter (PCT resistor) and a high-temperature thermistor (NTC).

4. (Amended) Temperature detection device according to Claim 1, wherein the standardized serial bus is one of an I^2C bus and a 3-wire bus.

5. (Amended) Temperature detection device according to Claim 1, wherein the temperature detection device is provided for a HF tuner.

6. (Amended) Temperature detection device according to Claim 5,
wherein the analog-to-digital converter is a part of an integrated PLL circuit of the HF tuner.

REMARKS

The above preliminary amendment is made to remove multiple dependencies from claims 4 and 5, and to replace the phrase "characterised in that" with "wherein" in claims 2 through 6. In addition, the reference numerals have been removed from the claims.

A new abstract page is supplied to conform to that appearing on the publication page of the WIPO application, but the new Abstract is typed on a separate page as required by U.S. practice.

Attached hereto is a marked-up version of the changes made to the claims by the current amendment. The attached page is captioned "Marked-up Copy".

Applicants respectfully request that the preliminary amendment described herein be entered into the record prior to calculation of the filing fee and prior to examination and consideration of the above-identified application.

If a telephone conference would be helpful in resolving any issues concerning this communication, please contact Applicants' primary attorney-of record, John J. Gresens (Reg. No. 33,112), at (612) 371.5265.

Respectfully submitted,

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By _____
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13027.23USWO

MARKED-UP COPY

1. Temperature detection device for an electronic circuit, comprising the following:

- a temperature detector, which at its output makes available a voltage [(V_t)] that is a predetermined function of the temperature;

- an analog-to-digital converter [(14),] to the input of which the temperature-dependent voltage [(V_t)] is applied; and

- a standardized serial bus [(16),] to which the output of the analog-to-digital converter [(14)] is coupled.

2. Temperature detection device according to Claim 1, [characterized in that] wherein the temperature detector consists of a voltage divider comprising a temperature sensor [(10)] and a resistance element [(12)].

3. Temperature detection device according to Claim 2, [characterized in that] wherein the temperature sensor [(10)] is a barretter (PCT resistor) or a high-temperature thermistor (NTC).

4. Temperature detection device according to [one of the claims 1 to 3,] claim 1, [characterized in that] wherein the standardized serial bus is an I^2C bus or a 3-wire bus.

5. Temperature detection device according to [one of the claims 1 to 4,] claim 1, [characterized in that] wherein the temperature detection device is provided for a HF tuner.

6. Temperature detection device according to Claim 5, [characterized in that] wherein the analog-to-digital converter (14) is part of an integrated PLL circuit of the HF tuner.

TEMPERATURE DETECTION DEVICE

Field of the Invention

The invention relates to a temperature detection device for an electronic circuit.

Description of the Prior Art

Nearly all the characteristic properties of electronic components depend on the temperature. Especially in the case of semiconductor components, most of the electrical parameters are temperature-dependent. As a consequence, the ambient temperature in places where electrical circuits are situated is of substantial significance with respect to the circuits' characteristics and parameters. The temperature resulting from operation of the circuits themselves also plays a role. For example, the gain and frequency response of an amplifier are temperature-dependent. It is desirable for information about the temperature to be available in order to determine the temperature dependence of electrical quantities and/or, where appropriate, to be able to compensate thermally induced deviations of electrical quantities.

Summary of the Invention

The object of the invention is to provide a temperature detection device for an electronic circuit which provides temperature information that can be further processed, while keeping the complexity and cost of construction of the device within tolerable limits.

In accordance with the invention there is provided a temperature detection device for an electronic circuit comprising:

- a temperature detector which outputs a temperature-dependent voltage that is a predetermined function of the temperature;
- an analog-to-digital converter, to an input of which the temperature-dependent voltage is applied;
- a standardized serial bus to which the analog-to-digital converter is coupled.

The temperature detection device in accordance with the invention can be constructed with little effort, at low cost. The temperature detector can be made of active and/or passive electronic components. The temperature behavior of most commercially available components is known, so that for the temperature detector the functional relationship between temperature and voltage is fixed. As analog-to-digital converter an integrated circuit is preferably used. In many cases an analog-to-digital converter is already present in the electronic circuit and can be used for the temperature detection device. By way of the standardized serial bus the temperature signal can be sent as a standardized digital signal to other electronic components for further processing.

Preferably the temperature detector is in the form of a voltage divider comprising a resistance element and a temperature sensor. This allows an output voltage that is a predetermined function of the temperature to be generated in a simple manner.

In an especially economical embodiment the temperature sensor is a temperature-dependent resistor. For this purpose both a barretter (PTC resistor) and a high-temperature thermistor (NTC) can be used. Instead of the temperature-dependent resistor it is possible to use other electronic components with known temperature behavior. For example, a transistor with known temperature dependence of its family of characteristics can also be used.

It can further be provided that the standardized serial bus is an I^2C bus or a 3-wire bus. By this means the device can be made compatible with other components in the electronic circuit. The temperature information is provided as a standardized serial digital signal and can be further processed by other componentry. Furthermore, the temperature information can also be sent to external circuits by way of the bus.

Preferably the temperature detection device is provided for a HF tuner. In the case of a tuner, the influence of temperature is especially important. A tuner must enable the receiving frequency in particular to be adjusted very precisely. Thermally induced fluctuations can impair the adjustment precision of the tuner directly or indirectly. If the temperature detection device makes available information as to the actual momentary temperature, undesired thermally induced deviations can be corrected. This process can occur both within the tuner and externally in a peripheral circuit, for example in a microprocessor.

In one economical embodiment it can be provided that the analog-to-digital converter is part of an integrated PLL circuit. In the tuners used today, a PLL circuit is ordinarily already present, usually as an integrated circuit. In many cases the integrated PLL circuit comprises an analog-to-digital converter that can be used for the temperature detection device. Similarly, in most tuners a standardized bus is present, which can likewise be used for the temperature detection device. In the most favorable case the temperature detection device in accordance with the invention can be implemented by adding only one part, namely the temperature detector.

In the following, a preferred embodiment of a temperature detection device in accordance with the invention is explained in detail with reference to the single drawing.

Brief Description of the Drawing

Figure 1 shows a circuit diagram of a temperature detection device constructed in accordance with the invention and incorporated into a HF tuner.

Description of the Preferred Embodiment

The preferred embodiment comprises a temperature sensor 10 and a resistance element 12. The temperature sensor 10 and the resistance element 12 are connected in series between a voltage source V_{cc} and a ground site 20, forming a voltage divider. The point where the temperature sensor 10 is coupled to the resistance

element 12 is at a temperature-dependent voltage V_t. Because the electrical and thermal properties of the temperature sensor 10 and the resistance element 12 are known, the relationship between the voltage V_t and the temperature is also known. As the temperature sensor 10, in particular a barretter (PTC resistor) or a high-temperature thermistor (NTC) can be used. Transistors and similar elements with known temperature behavior can in principle also be used as the temperature sensor 10. The temperature sensor 10 and the resistance element 12, connected in series between a voltage source V_{cc} and ground, together form a temperature detector. The coupling point between temperature sensor 10 and resistance element 12 forms an output of the temperature detector.

By way of its output, the temperature detector is coupled to an analog-to-digital converter 14. The analog-to-digital converter 14 transforms the temperature-dependent voltage V_t into a standardized digital data element. The analog-to-digital converter 14 is part of an integrated PLL circuit 18. This integrated PLL circuit 18 is in turn a component of a HF tuner. The HF tuner also comprises a standardized serial bus 16. The standardized serial bus 16 preferably has the form of an I^2C bus or 3-wire bus. The serial bus 16 is coupled to the integrated PLL circuit 18. Within the integrated PLL circuit 18, the serial bus 16 is coupled to the output of the analog-to-digital converter 14. This arrangement allows the serial bus 16 to deliver a compatible digital signal from the analog-to-digital converter 14, which contains information about the

sensed temperature and can be further processed by other componentry.

Circuits that can be used as the integrated PLL circuit 18 include, for example, the commercially available circuits TSA 5522 and TSA 5523, both of which comprise an internal analog-to-digital converter. Furthermore, both of these integrated components can be controlled by way of an I^2C bus.

By means of the temperature detection device in accordance with the invention the actual momentary temperature can be expressed as a standardized digital signal and thus sent to other components within the tuner and also to external devices. For example, a microprocessor and a semiconductor memory unit, in particular an electrically erasable semiconductor memory (EEPROM), can be connected to the serial bus 16. This enables the temperature-dependence of electrical parameters of the tuner to be measured and stored in the semiconductor memory. With the device in accordance with the invention it is possible to detect the momentary temperature during operation and, where required, to respond to undesired thermally-induced deviations. In taking such compensatory measures, the stored calibration curves can be used as a basis for calculation.

The temperature detection device in accordance with the invention is in principle suitable for any electronic circuit. The temperature detection device is especially advantageous for circuits that already comprise an analog-to-digital converter and/or a serial

bus. In the latter case, the temperature detection device can be implemented very simply and hence at low cost.

List of reference numerals

10 Temperature sensor

12 Resistance element

14 Analog-to-digital converter

16 Serial bus

18 Integrated PLL circuit

20 Ground